Lecture

Module 13: Landscape-Level Conservation of Biodiversity

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Learning Objectives

Upon completion of this module, the participant will be able to:

1. Explain how habitat loss and fragmentation affect biodiversity.

2. Describe the different types of habitat fragmentation and the consequences to biodiversity for each.

3. Explain the metapopulation concept and its implications for land management.

4. Describe how landscape level biodiversity concepts can be integrated into natural resource planning and management.

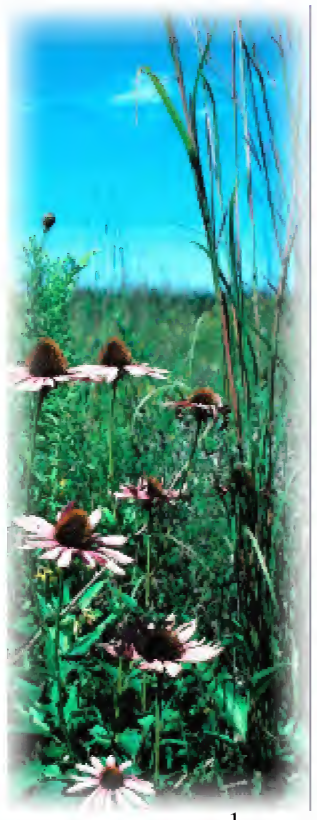
Lecture Outline

Threats to biodiversity at the landscape level
- Habitat loss
- Habitat fragmentation
- Quality of matrix

Habitat loss

Habitat fragmentation
- Types of fragmentation
  - Traditional fragmentation
  - Perforation
  - Dissection (internal fragmentation)
- Effects of fragmentation
  - Reduction in area
    - Area-sensitive species
  - Increase in edge
    - Edge-sensitive species
  - Increase in isolation

Quality of matrix
- Land use – urban, agriculture, protected



USDA

- Metapopulation concept
- Reconnecting fragmented landscapes
  - Movement corridors
    - Rationale for movement corridors
    - Types of movement corridors
    - Potential disadvantages of movement corridors
    - Checklist to design movement corridors
    - Design parameters of movement corridors
- Managing for biodiversity
  - Species approach
  - Ecological process approach
  - Landscape approach
  - Need to work across administrative boundaries

Exercises

A) Classroom Exercises

1. For the landscape where you live, itemize human activities that:

   - convert natural ecosystems to human uses

   - fragment ecosystems (include activities that perforate and dissect landscapes as well as "traditional" fragmentation activities)

   - degrade the overall landscape in terms of water quality, soil retention, and maintenance of plant and animal communities.

Are all activities distinct from each other or do several contribute to all three changes? Can you see any similarities and differences among these activities?

2. For the area where you work, devise a list of actions that would:

    - increase area of habitat patches

    - decrease the amount of edge of these patches

    - increase the connectivity of the patches.

    Because this would obviously take time, and most certainly wouldn't be easy, develop a time line during which these actions would occur. Do not focus on public lands; include as much private land as you can in your plans. Be specific in listing strategies to implement your vision of a landscape that is less fragmented than what it is today. How many of your solutions fit within an ecological framework? The socio-political framework? How economically realistic are they, given today's climate? What would it take for them to be more feasible?

3. Where you live and work, list the natural and human-made (e.g., highway underpasses) wildlife corridors. What do they connect? How heavily impacted are they by human activities? What is being done to protect and enhance these areas? What governmental and non-governmental organizations are responsible for them? Do these groups recognize them as movement corridors for wildlife? Are there things that you can do in your job that will help ensure the connectivity of your area so wildlife can move safely from area to area?

4. Chose two natural areas where you live or work and design a movement corridor that will connect them. List the areas to be protected so the corridor works, the species chosen for this project, aspects of the species' life history that will determine your design recommendations, and management actions that will have to occur to ensure the corridor's utilization. How much of your corridor occurs on private lands? What special recommendations can you make for working effectively with the private landowners? Include suggestions for a monitoring plan to see if the corridor is utilized.

B) Field Exercises

1. Visit different-sized patches of the same ecosystem type and count the number of species in a particular taxa you can readily identify (e.g., birds, butterflies, trees). In class, plot the number of species seen against area of the patches visited. Do more species occur in the larger patches? Critique your findings.

2. Design an exercise where you measure an edge effect, whether for abiotic, edge-generalist species, or human effects. For example, in remnant patches of natural ecosystems (e.g., woodlots, grasslands) where you live begin at the edge of the patches and moving towards the center, record the distances where you see evidence of human activities. These may include grass clippings, Christmas trees, rubble and litter, dumps, hacked trees, forts or tree houses, etc. Another example might be to set out peanuts or some other food attractive to animals, at different distances from the patch edge and measure the "predation rate" of them over several days. For abiotic effects, you could take temperatures, wind speed, or relative humidity readings at different distances from a forest edge. Use your imagination and think up ideas on your own. Back in class, plot your findings against the distance from the patch's edge. Any evidence of an edge effect? How might you improve your study? What predisposes humans to be particularly effective "edge-generalist species"?

Study Questions

1. Land use actions associated with housing developments and agricultural production can affect biological diversity by perforating, fragmenting or dissecting contiguous habitats. Which of these types of human-induced changes to a landscape pose the greatest threat to terrestrial wildlife and why?

2. Dr. Knight referred to landscapes as matrices of different land uses. What is a key component of a healthy or high quality matrix?

3. Why is private land likely to be disproportionately important from the standpoint of conservation of biological diversity, especially in the West?

4. Describe two “Ecological Process” approaches to conservation of biological diversity.

References and Selected Reading

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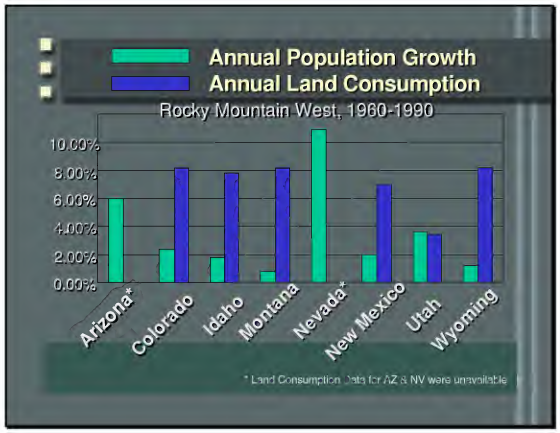
Slides used in lecture

Slide 1



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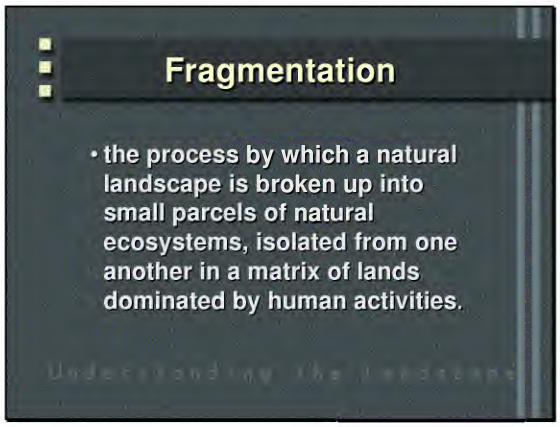

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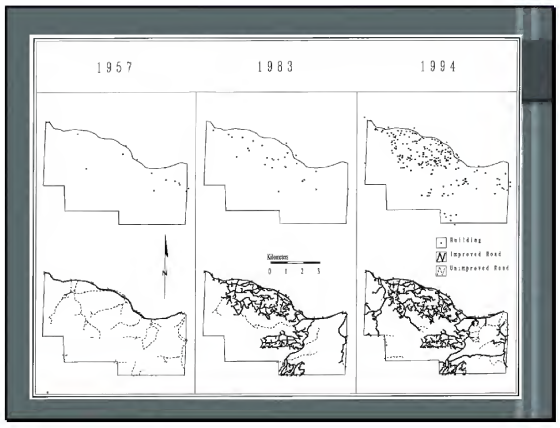

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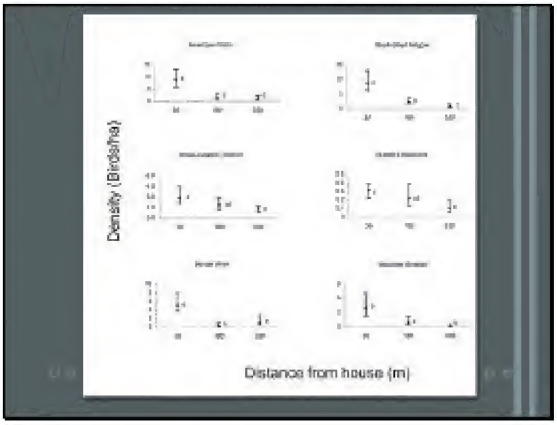

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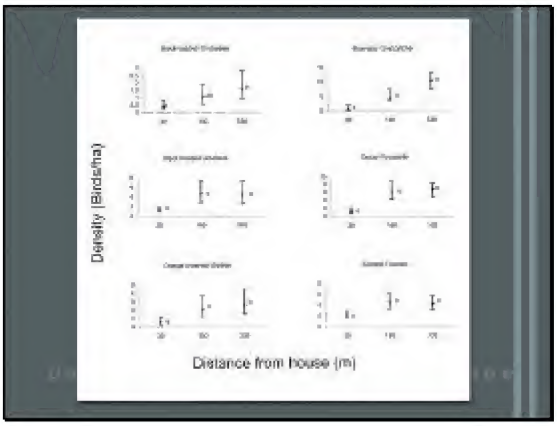

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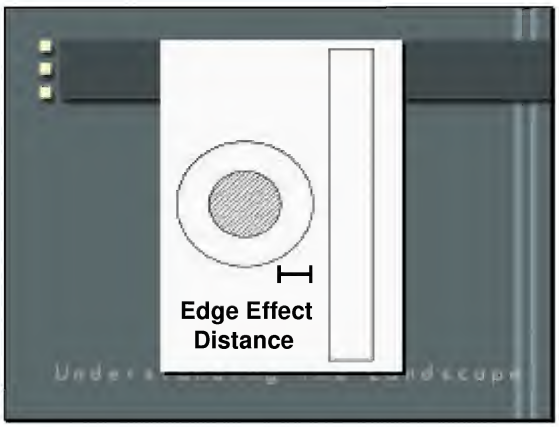

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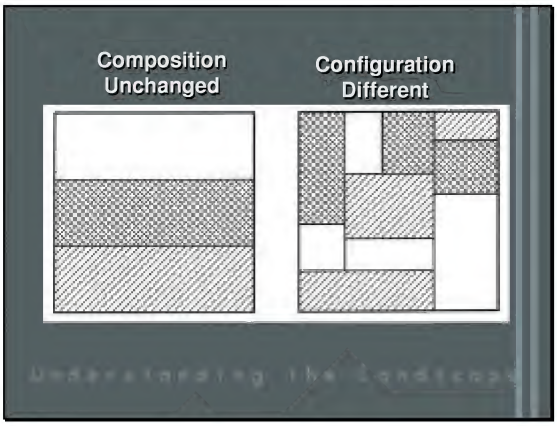
Dispersal-Sensitive Species

- species whose fitness (ability to survive and reproduce) decreases in fragmented landscapes, due to physical, behavioral, physiological limitations; or elevated mortality rates from having to cross human-dominated landscapes.

Understanding the Landscape

Slide 11



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Matrix

- the most connected and extensive landscape element type. It can include both human land-uses and vegetation communities.

Understanding the Landscape

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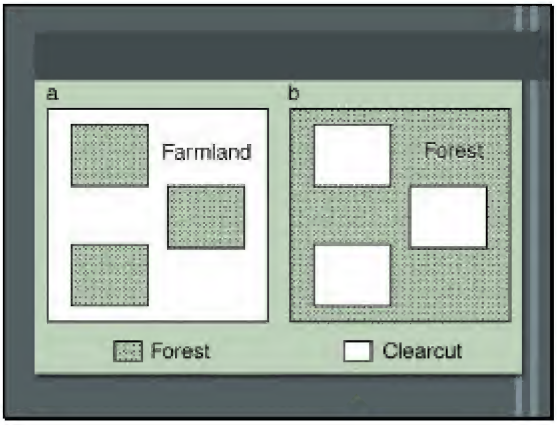

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Metapopulation

- a population existing as a number of spatially discrete populations distributed among habitat fragments and connected via dispersal.

Understanding the Landscape

Slide 15

Metapopulation

- Source - a discrete population where productivity exceeds mortality; a self-sustaining population.
- Sink - a discrete population where productivity is less than mortality; is not sustainable without immigration of individuals from other populations.
- Rescue effect - when source populations bolster sink populations through dispersing individuals.

Understanding the Landscape

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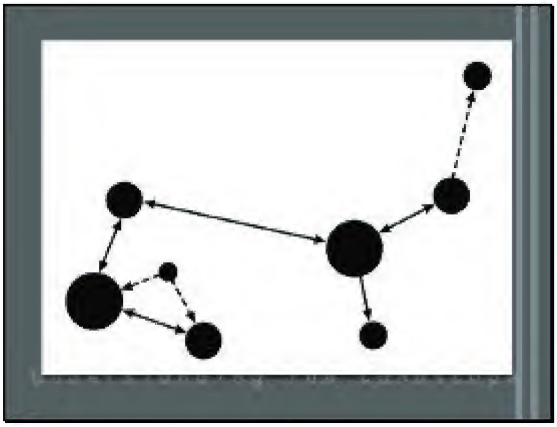

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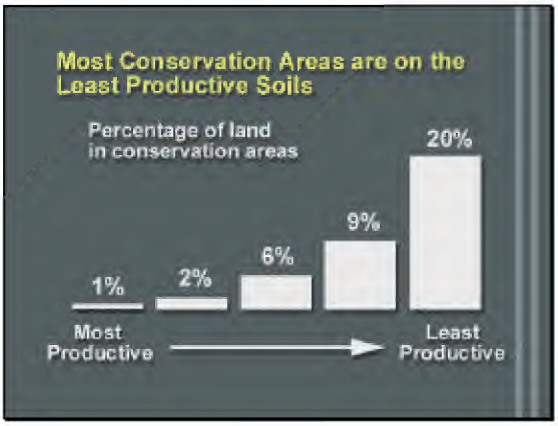

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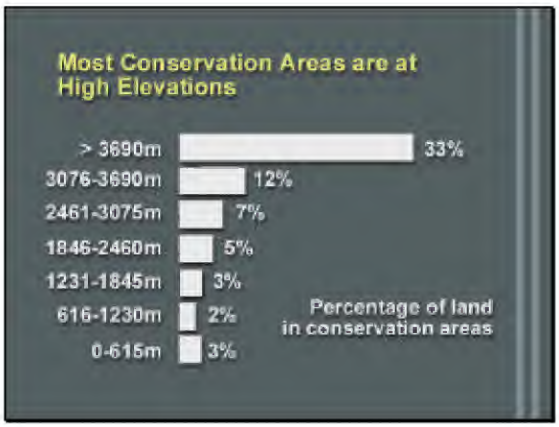

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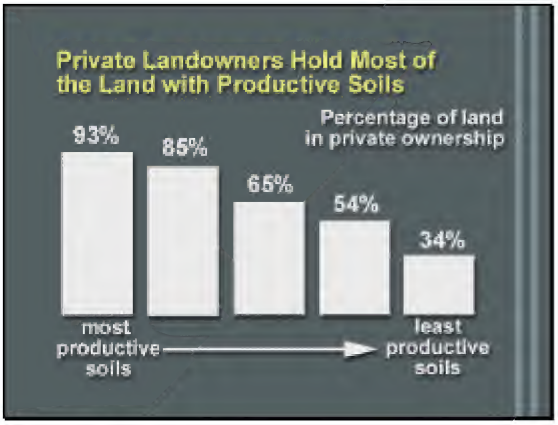

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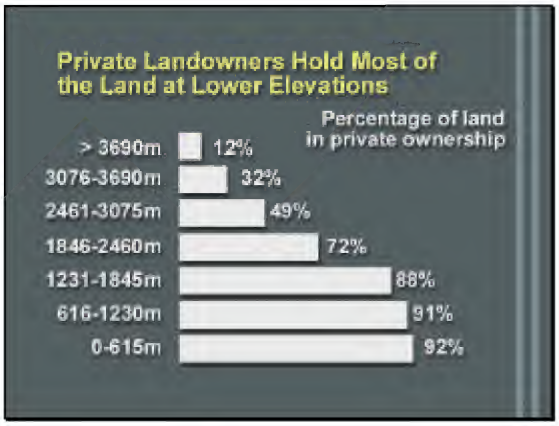

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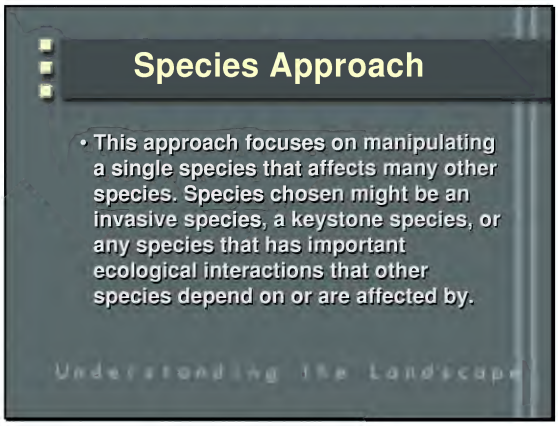

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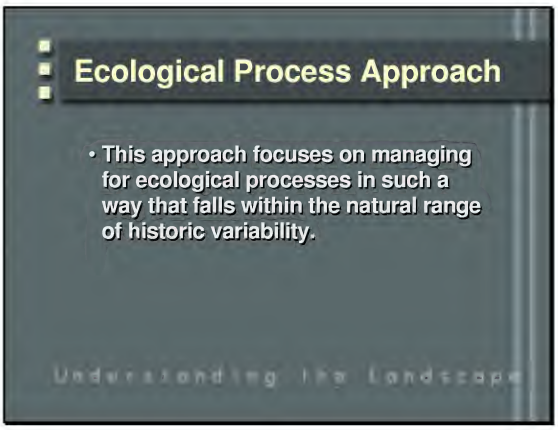

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Landscape Approach
• This approach concentrates on landscape elements and their size, shape, and juxtaposition
Understanding the Landscape